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We Present

The Easy-Reading Page

IN AN EFFORT to relieve readers of eye-strain, with its attendant fatigue and discomfort, or worse, ELECTRICAL ENGINEERING introduces with this issue some of the indirect results of extensive research by noted illumination and research authorities in the field of "effective seeing"—a hopeful step toward a much-needed "easy-reading page." This issue is printed on new paper of an improved quality, blended and toned scientifically to provide the foundation for an effective non-glare easy-reading page. Typography, too, has been modified in the interests of reader-comfort. Even the ink, which after all makes a periodical out of otherwise blank paper, has been specially compounded to contribute toward the desired results, and in all probability will be improved still further in the future.

Concerning this change, Maurice Holland (A'23, M'30) director, division of engineering and industrial research, National Research Council, has written the following statement:

"I have been advised on good authority that 70 per cent of our current knowledge comes to us through the medium of the printed page. Therefore, especially in view of the recent notable advances in the science and art of electrical illumination, it would seem that we have not carried through to the ultimate conclusion, so far as the reader is concerned.

"Particularly as exemplified in the 'better light, better sight' campaign, much scientific and technical effort has been focused with pronounced success on such modern illuminants as the 'IES lamps.' But all this has had to do with the *source* of the light. Therefore, it seems not only timely, but highly important that thoughtful attention should be given to the question of effective *utilization* of light, particularly with reference to the printed page.

"The advance samples of the January 1937 issue of ELECTRICAL ENGINEERING that I have seen represent the nearest to a scientifically developed easy-reading page that so far has been produced through the media of the graphic arts. It is a definite contribution. It is a definite challenge. An easy-reading page involves not only the paper on which it is printed, but, to be most effective, should represent the co-operative effort of printers, ink manufacturers, type designers, and other elements of the graphic arts."

Frankly an experiment, this step represents ELECTRICAL ENGINEERING's effort to serve its readers in the most effective manner possible. Comments are invited.

A Million-Cycle Telephone System

ABOUT 2 years ago a new wide-band system for multichannel telephone transmission over coaxial cables was described in an AIEE paper.[1] An experimental system has now been installed between New York and Philadelphia. The various tests and trials which are planned for this system have not been carried far enough to justify a formal AIEE technical paper for presentation and discussion. Meanwhile, the considerable interest that has been aroused in the system has led to this brief statement of its principal features and its general technical performance as so far measured, which has been prepared by M. E. Strieby (M'22) carrier transmission research engineer of the Bell Telephone Laboratories, Inc., New York, N. Y.

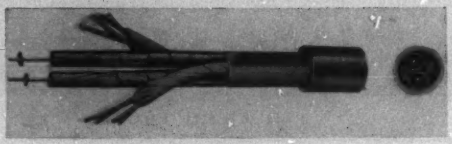

Fig. 1. View showing structure of coaxial cable

The coaxial cable itself has been installed between the long-distance telephone buildings in New York and Philadelphia, a distance of 94.5 miles. It has been equipped with repeaters, at intervals of about 10 miles, capable of handling a frequency band of about 1,000,000 cycles.

This million-cycle system is designed to handle 240 simultaneous 2-way telephone conversations. Only a part of the terminal apparatus has been installed, sufficient in this case to enable adequate tests to be made of the performance of the entire system. A general view of the New York terminal is shown in figure 2. Some preliminary test conversations have been held over the system both in its normal arrangement for providing New York-Philadelphia circuits, and with certain special arrangements whereby the circuit was looped back and forth many times to provide an approximate equivalent of a very long cable circuit. The performance has been up to expectations, and no important technical difficulties have arisen to cast doubt upon the future usefulness of such systems. Much work remains to be done, however, before coaxial systems suitable for general commercial service can be produced.

The Coaxial Cable

Figure 1 shows a photograph of the particular cable used in this installation. It contains 2 coaxial units, each having a 0.265-inch inside diameter, together with 4 pairs of 19-gauge paper-insulated wires, the whole enclosed in a lead sheath having a $^{7}/_{8}$-inch outside diameter. The central conductor of the coaxial units is a 13-gauge copper wire insulated with hard-rubber disks at intervals of $^{3}/_{4}$ inch. The outer conductor is made up of 9 overlapping copper tapes which form a tube 0.02 inch thick; this is held together with a double wrapping of iron tape.

The transmission losses of this coaxial conductor at various frequencies are shown in figure 5. This attenuation is about 4 per cent higher than is calculated for a solid copper tube of the same dimensions and material. Another matter of importance is the shielding obtained from

1. Systems for Wide Band Transmission Over Coaxial Lines, by L. Espenschied and M. E. Strieby, Electrical Engineering (AIEE Transactions), volume 53, 1934, pages 1371–80.

Fig. 2. The New York terminal of the coaxial system

1937 Index—Electrical Engineering and Transactions

This multientry annual reference index covers comprehensively the entire text content of the 12 issues of ELECTRICAL ENGINEERING published during 1937 and the identical content of the 1937 AIEE TRANSACTIONS, volume 56; the index covers also a supplement of 28 pages published in the TRANSACTIONS, which contains the following two papers not published in ELECTRICAL ENGINEERING:

1. FUNDAMENTAL CONCEPTS OF SYNCHRONOUS MACHINE REACTANCES, by B. R. Prentice (pages 1–21 of supplement).

2. PER-UNIT QUANTITIES, by Irven Travis (pages 22–8 of supplement).

A special effort has been made to provide effective correlation between references to technical papers and all published discussions of those papers. Discussions of many technical papers published during the latter part of 1936 were published in the early part of 1937, and hence appear in this current index. Likewise, many discussions of the later 1937 papers will be published early in 1938, and consequently will not be found among the references contained in this current index.

For convenience in use, this index is subdivided into the following general sections:

1. Technical subjects.
2. Authors, including the writers of discussions.
3. News items pertaining to Institute activities.
4. News items of a general nature.
5. Biographical (personal and obituary) items.

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High Lights

Synchronous Machines. Synchronous machines are analyzed in 3 papers in this issue. In the first, synchronous-machine theory has been extended to include the effect of armature-circuit capacitance in the general equations for the performance of a salient-pole machine (*pages 41–8*). The second paper presents an extension of the 2-reaction theory of synchronous machines (*pages 37–31*). The third paper presents a mathematical analysis of the synchronous machine from the point of view of field-distribution theory, a departure from the usual method of considering machine performance by means of circuit theory (*pages 49–58*).

Lightning Investigations. Lightning investigations on power systems are reported in 2 papers in this issue. One shows that lightning protection for low-voltage lines, particularly wood-pole lines, may be obtained at low cost by using lightning-protector tubes on one phase of a 3-phase circuit, the conductor so equipped becoming a shielding conductor for the others (*pages 13–16*). The second paper reports the results obtained during 1935 and 1936 in an investigation that has been carried on over a period of several years on certain lines (*pages 101–06*).

Watt-Hour Meters. Watt-hour meters form the subject of 2 papers in this issue. One discusses meter bearings; sapphire jewels and cobalt-tungsten pivots have been found superior in tests on a number of materials. Lubrication is recommended for bearings of the pivot type, but not for the ball type (*pages 129–37*). In the second paper, factors affecting the performance of watt-hour meters, and their influence in the design of a new type of meter, are described (*pages 172–9*).

Suspension-Insulator Characteristics. Suspension-insulator units have electrical characteristics that vary with time, humidity, and stress. Moisture and corona have been found to produce deposits that affect the surface resistance and cause a hysteresis effect in the characteristics. Temperature affects the characteristics indirectly, in that absolute humidity of air is a function of temperature (*pages 59–66*).

Winter Convention. Final arrangements for the Institute's 1937 winter convention to be held in New York, N. Y., January 25–29, are being completed. The convention will mark the resumption of a 5-day winter convention schedule, and will include the usual social and entertainment features and inspection trips, in addition to the 13 technical sessions scheduled (*pages 190–2*).

Inductive Co-ordination. A study of inductive co-ordination of common-neutral power-distribution systems and telephone circuits, conducted jointly by power and communication engineers, has led to some important conclusions concerning this problem. It is believed that where power and telephone people view the matter as a mutual responsibility and fully co-operate, adequate over-all co-ordination readily can be secured (*pages 17–26*).

Pole Flexibility. Flexibility of poles may be of importance under certain conditions in the design of an overhead line, although poles ordinarily are considered rigid. A paper in this issue describes the general method of attacking the problem of pole flexure, and solutions are given in detail. Simpler rules for use in the field also are mentioned (*pages 91–100*).

Reclosure of Lines. Reclosure of circuit breakers on high-voltage transmission lines with the maximum speed that physical phenomena will permit makes possible a high degree of service continuity from a single transmission line. A complete operation in approximately 20 cycles on a 60-cycle system is said to effect a material reduction in outages caused by lightning (*pages 81–90*).

Overhead Distribution. Secondary distribution by overhead conductors and transformers has been studied by 5 companies from an economic standpoint, and a comparison of the results of these studies indicates that the progressive method of distribution design, which provides additions rather than replacements, is the most economical (*pages 114–22*).

Brush Wear. Results of investigations of the wear of electrical brushes are presented in 2 papers in this issue. In one, abrasion is shown to be an important factor in brush wear (*pages 8–12*). The other shows that wear of both rings and brushes can be reduced by operating them in an oxygen-free gas (*pages 132–8*).

Expansion Theorems. Solutions for the current-electromotive force relations of networks such as filters and artificial lines, which lead to difference equations, may be given in the form of expansion theorems similar to Heaviside's expansion theorem and its extensions by the application of Laplace transformations (*pages 153–8*).

Service Restorer. Automatic service restorers for high-capacity transmission and distribution systems have been improved greatly during the last few years, but the need for such equipment on systems of lower capacity has necessitated the development of a new type of unit (*pages 180–2*).

Transformers. Transformers are discussed in 2 papers in this issue. The first outlines certain proposed changes in the AIEE transformer standards (*pages 32–6*). The second paper presents the results of a series of dielectric tests on transformer oil and solid insulation (*pages 164–71*).

Impulse Generator Charts. Comparison of the voltage waves of impulse generators for commercial testing on the basis of the constants of the generator circuit as well as wave shape is suggested in a paper in this issue; charts for selecting circuit constants are included (*pages 183–8*).

Directional Relay. A relay of the polyphase directional type having only a single element has been developed by the use of multiple poles. Reducing the number of elements has reduced the size and weight of the relay, and has resulted in low inertia and high speed (*pages 77–80*).

Sealed-Off Ignitrons. Ignitrons offer a means of control for resistance welding by their ability to supply very large currents for fractions of a cycle. Principles of design and manufacturing technique for both glass and metal tubes of the sealed-off type are discussed in this issue (*pages 37–40*).

Spark-Over of Gaps. Spark-over of sphere and rod gaps, insulators, bushings, and solid insulation for very short time lags has been investigated and some data obtained for the range from 0.2 to 4 microseconds, on which little has been published (*pages 67–76*).

Distribution Protection. Adequate overcurrent protection on distribution systems is necessary in order that a utility company may maintain proper continuity of service; some modern trends are discussed in this issue (*pages 138–52*).

Electrostatic Precipitator. In order to keep abreast of the rapidly growing need for better methods of cleaning air, a new electrostatic precipitator has been devised (*pages 159–63*).

Cruise to Bermuda. A post-convention cruise to Bermuda at special rates is offered those attending the AIEE 1937 winter convention (*pages 191, 192*).

Prizes for Papers. All technical papers presented at Institute meetings during the calendar year 1936 are eligible for prizes (*page 193*).

Commutator Flashing. A knowledge of arc characteristics is of value in investigations of commutator flashing (*pages 107–13*).

Statements and opinions given in articles and papers appearing in ELECTRICAL ENGINEERING are the expressions of contributors, for which the Institute assumes no responsibility. Correspondence is invited on all controversial matters. ¶ Subscriptions—$12 per year to United States, Mexico, Cuba, Porto Rico, Hawaii, Philippine Islands, Central and South America, Haiti, Spain, Spanish Colonies; $13 to Canada; $14 elsewhere. Single copy $1.50. ¶ Address changes must be received by the fifteenth of the month to be effective with the succeeding issue. Copies undelivered because of incorrect address cannot be replaced without charge. ¶ ELECTRICAL ENGINEERING is indexed annually by the Institute, weekly and monthly by *Engineering Index*, and monthly by *Industrial Arts Index*; abstracted monthly by *Science Abstracts* (London). ¶ Copyright 1937 by the American Institute of Electrical Engineers. Number of copies this issue—20,700.

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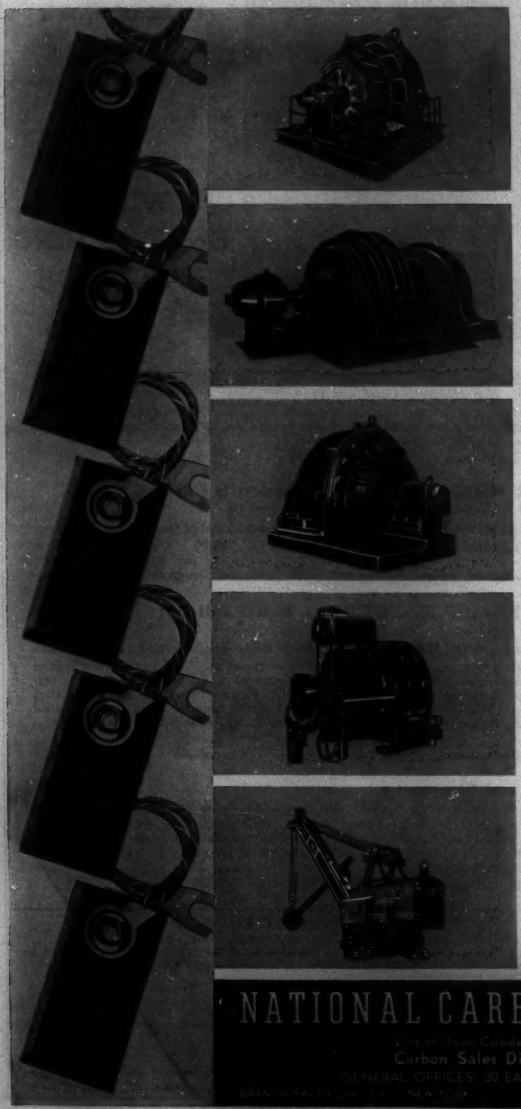

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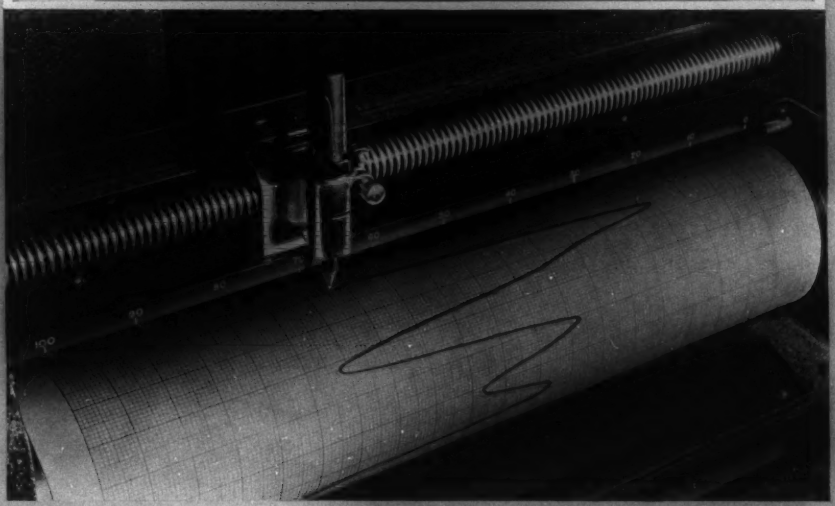

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